NASA/CR-97-

206755

Final

7N-81-R
O-IT
056352

Technical Report

NCC2-902

Utilizing the EUVE Innovative Technology Testbed to Reduce Satellite Operations Cost for Present and Future Orbiting Missions

December 22, 1997

The Center for EUV Astrophysics,
a unit of the Space Sciences Laboratory,
University of California at Berkeley

Utilizing the EUVE Innovative Technology Testbed to Reduce Satellite Operations Cost for Present and Future Orbiting Missions

Introduction

This report summarizes work done under Cooperative Agreement (CA) No. NCC2-902 for NASA's Ames Research Center (ARC) by the University of California at Berkeley's (UCB) Center for EUV Astrophysics (CEA). This CA covered collaborative work between UCB/CEA, ARC, and various other entities on the following testbed projects:

- TERRIERS -- The development of the ground systems to support the TERRIERS satellite mission at Boston University (BU).

- HSTS -- The application of ARC's Heuristic Scheduling Testbed System (HSTS) to the EUVE satellite mission.

- SELMON -- The application of NASA's Jet Propulsion Laboratory's (JPL) Selective Monitoring (SELMON) system to the EUVE satellite mission.

- EVE -- The development of the EUVE Virtual Environment (EVE), a prototype three-dimensional (3-D) visualization environment for the EUVE satellite and its sensors, instruments, and communications antennae.

- FIDO -- The development of the Fault-Induced Document Officer (FIDO) system, a prototype application to respond to anomalous conditions by automatically searching for, retrieving, and displaying relevant documentation for an operator's use.

TERRIERS

The TERRIERS project was a collaborative effort between BU, ARC, and CEA, whose purpose was to develop and implement a ground system for the operations of the TERRIERS satellite.

Under this CA, CEA was to develop and deliver to BU, as part of the TERRIERS ground system, a data archiving and serving system. CEA started developing this software in early 1995 and delivered the operational system in 1996. This system provides the following functions:

- A means of transferring files between the BU Sun workstation and a Macintosh computer at the ground station in Herndon, VA.

- A system for saving incoming data on secondary media.

- A system for converting TERRIERS schedules into protocol-specific messages required by the spacecraft.

- A system for archiving the TERRIERS data and providing access to it in a manner that is appropriate to its processing needs.

2

CEA has completed its work on this project. Our delivered system has met all its stated requirements and is ready for operational use. Unfortunately, the TERRIERS satellite has not yet launched due to problems with the spacecraft and with the non-CEA-developed parts of the ground systems.

HSTS

HSTS was a collaborative effort between CEA and ARC to field a working example of a new scheduling algorithm developed at ARC. A commercial company called HRI (Heuristics Research, Inc.) was also involved but subsequently disbanded. The purpose of this project was to apply ARC's HSTS application to the satellite domain, specifically that of EUVE science planning.

Under this CA, CEA was to provide a software interface to ARC's HSTS application, to complete the user interface (this was originally HRI's responsibility), and to test out the integrated HSTS as applied to EUVE science planning. In early 1996 CEA delivered its software and performed its evaluation of the system. HSTS currently accurately plans three of the eight different EUVE observation types, and shows some promise for future operational use. Unfortunately, a number of outstanding problems remain that preclude it from current use in operations: it currently applies to only the most basic and simple EUVE observations (~10% of the total), the HSTS application has significant performance problems, and the user interface still needs a fair amount of work.

SelMon

The SELMON project was a collaborative effort between CEA, ARC, and JPL. The purpose was to apply JPL's SELMON application to the satellite domain via the EUVE telemetry stream, and to evaluate the system's usefulness to mission operations.

Under this CA, CEA was to provide a data server to interface the EUVE telemetry stream to the SELMON application, and to evaluate SelMon's performance and its potential application to EUVE mission operations. In 1996, CEA delivered the data server and performed its evaluation of SELMON, which showed some potential usefulness to EUVE (or other satellite) mission operations, particularly in view of today's climate for "lights out" operations.

However, a number of problems remain with the SELMON application that preclude its operational use for EUVE. Throughout 1996, CEA continued to supply JPL with EUVE telemetry data so that JPL could continue to refine, test, and upgrade SELMON.

EVE

The EVE project was a collaborative effort between CEA, ARC, and GSFC. The purpose was to develop a system to provide a 3-D virtual environment in which to visualize EUVE spacecraft orientations, and the fields-of-view (FOVs) of satellite subsystems (e.g., the payload telescopes, and spacecraft sensors and communications antennae). The idea was that such a tool would be very useful to spacecraft engineers and mission planners for anomaly response and for training.

Under this CA, CEA was to provide a data server to interface the EUVE telemetry stream to a 3-D graphics renderer, and to evaluate the overall system for its potential use in operations. In 1996, CEA delivered a data server and evaluated the working prototype, which was limited to handling only playback telemetry (i.e., no real-time or predictive

modes). CEA's evaluation of the prototype indicated that a more robust system could indeed be very useful to spacecraft engineers and mission planners.

Unfortunately, the existing prototype system has some significant problems that preclude its operational use at the present time. Both the data server and the 3-D graphics rendering systems have significant performance problems and not all of the spacecraft sensor FOVs have been implemented. The rendering is dependent on proprietary computer hardware (Silicon Graphics, Inc.), which precludes its portability and remote usage and there are numerous various minor bugs in the rendering software that result in inaccurate displays. Most of these problems, however, can easily be resolved.

FIDO

The FIDO project was a collaboration between CEA and ARC. The purpose was to design and implement a software tool that would respond to anomalous log entries (i.e., from system processes) by automatically searching for, retrieving, and displaying relevant information resources to assist an operator in resolving the problem.

Under this CA, CEA was to develop the overall system. In 1996, UCB completed and delivered a prototype system that included a Web-based user interface to a suite of software utilities (most of which were publicly available) to watch system files for error messages, trigger searches of its "knowledge base" for relevant information, and retrieve and display the context-specific information.

The existing FIDO system is not yet totally functional. All of the individual pieces have been implemented and tested to work, but the overall system has not yet been fully integrated. In addition to finishing off the required development work, there are a few other problems that currently limit the usefulness of such a system: the general lack of relevant and/or up-to-date on-line documents (most of the relevant legacy EUVE documentation is in hardcopy form), and the very basic and simple indexing scheme limits the applicability of the retrieved documents to the actual anomaly.

End of report